

Artificial Intelligence in Adolescent Mental Health Education: A Quantitative Study of Public Junior High Schools in Northern China

Liu Xingchen, and Roselan Baki

Abstract – This study takes public junior high schools in Northern China as the research object, aiming to quantitatively explore the application status, acceptance level, influencing factors and promotion feasibility of artificial intelligence (AI) tools in adolescent mental health education. At present, mental health education in junior high schools in Northern China is faced with a series of practical challenges, including a shortage of professional teachers, huge regional and urban-rural resource gaps, a single curriculum form and insufficient personalized services. AI tools (such as auxiliary curriculum systems, intelligent early warning platforms and personalized guidance tools) have the potential to break through these bottlenecks. This study adopts a cross-sectional quantitative design, and selects students, mental health teachers, head teachers and parents from Beijing, Hebei, Gansu and Heilongjiang through multi-stage stratified random sampling. Data are collected by means of validated scales and self-designed questionnaires, and analyzed through descriptive statistics, correlation analysis and structural equation modelling. It is anticipated that users' perceived usefulness and perceived ease of use will positively predict their acceptance intention, while privacy concerns, mental health stigma and low digital literacy will exert negative inhibitory effects. Meanwhile, there are significant regional and urban-rural differences in the demand for and acceptance of AI tools. This study will provide supplementary evidence for cross-regional quantitative research on the integration of AI into school mental health education in Northern China, and put forward operable and regionally adaptive suggestions for constructing an AI-assisted mental health education system.

Keywords –Artificial Intelligence (AI); Adolescent Mental Health Education; Public Junior High Schools in Northern China; Quantitative Research; Regional Differences

I. INTRODUCTION

Research Background

Affected by increasing academic pressure, strained family relationships, rapid social and cultural changes and the digital environment, adolescent mental health problems have become an important public health issue to be urgently addressed in China. In recent years, a large number of have shown that the incidence and prevalence of psychological problems such as anxiety, depression and behavioural disorders among Chinese adolescents are on the rise. The high-pressure education system, parents' high expectations and limited channels for emotional expression have further exacerbated these problems. According to the data from the

World Health Organization (WHO, 2025), approximately 14% of adolescents aged 10-19 worldwide suffer from some form of mental disorder, a proportion that reflects the enormous psychological risks faced by the adolescent group. The latest data released by The Lancet Regional Health-Western Pacific in 2025 show that the overall prevalence of mental disorders among children and adolescents in China is as high as 19.3%. This figure not only highlights the universality and severity of adolescent mental health problems, but also indicates that such problems have evolved from individual predicaments into an undeniable social issue (Wang & Wei, 2025). However, in most developing countries, due to insufficient social cognition, scarce mental health resources and cultural stigma, adolescent mental problems have not received adequate attention and systematic intervention (Kieling et al., 2011).

In the field of school mental health education, public junior high schools in Northern China are confronted with more prominent structural bottlenecks. Northern China has a vast territory, and there are significant differences in economic development level, educational resource endowment and digital infrastructure among North China, Northwest China and Northeast China. Especially in county-level rural junior high schools in Northwest and Northeast China, many schools do not have full-time mental health teachers, and most mental health education courses are taught by head teachers who have not received professional training, leading to uneven educational quality. At the social level, there are still problems such as lack of mental health knowledge, insufficient cognition, unsmooth referral mechanisms and inadequate synergy among various parties (Zhou, 2023). The existing mental health education mostly adopts a unified "one-size-fits-all" teaching model, which cannot meet the personalized psychological development needs of students with different grades, genders and family backgrounds, and it is also difficult to effectively improve students' mental health literacy. The integrated application of artificial intelligence technology has become a potential path to break through the above bottlenecks in mental health education and bridge the regional and urban-rural gaps in Northern China.

This study is an extended and targeted research based on the author's published qualitative study *Application of Artificial Intelligence in Adolescent Mental Health Support: A Qualitative Study in Chinese Middle Schools* (Liu & Lee, 2025). Different from the original study which focuses on the general mental health support scenario, this study centres on adolescent mental health education in the school context, adjusts the research object to public junior high schools in Northern China, and transforms the exploratory qualitative research design into a confirmatory quantitative one. It aims to provide regionally targeted quantitative evidence for the

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application of AI in school mental health education and fill the research gap in the integration of AI and mental health education in junior high schools in Northern China.

II. PROBLEM STATEMENT

Problem Statement

Mental health education in primary and secondary schools in China has gone through four stages: the investigation and appeal stage in the early 1980s, the attempt and exploration stage in the mid-to-late 1980s, the development and promotion stage in the early 1990s, and the stage of comprehensive attention and overall development in the mid-to-late 1990s. Paying attention to the healthy growth of adolescents has become a consensus among the majority of educators. Despite the continuous improvement of public cognitive level of mental health and the increasing national attention to adolescent mental health with the changes of the times, China's school mental health education system is still in the initial stage of development and faces many structural and practical challenges.

First of all, Fu (2003) pointed out that from the perspective of national mental health education, there are imbalances in regions, quantity and quality. In terms of regions: the south is better than the north, the east is better than the west, and cities are better than rural areas. In terms of schools: after more than ten years of unremitting efforts, some schools have achieved excellent results; some schools have carried out a variety of colorful school mental health education activities and achieved certain results; there are also some schools, especially those in remote areas with underdeveloped economy, blocked information, outdated concepts and conservative thinking, which are awakening or making efforts. In terms of the teaching team: some psychological counseling teachers have received professional training, have a solid theoretical knowledge of pedagogy and psychology, and are specially engaged in school psychological counseling work with rich practical experience. These teachers are the backbone of the current mental health education. Some other psychological counseling teachers are transferred from physiology and health teachers and moral education teachers, but after several years of training and self-study, most of them have basically mastered the methods and skills of school psychological counseling and can basically complete the school mental health education work. There is still a part of psychological counseling teachers who are transferred from non-teaching staff or teachers who are not competent for teaching tasks due to the needs of the situation. These teachers have a weak foundation in educational theory, lack professional knowledge of mental health education and have little practical experience, so it is difficult for them to be competent for school mental health education work. Mental health education in such schools is generally a mere formality and difficult to achieve practical results. As mentioned above, the south is better than the north, the east is better than the west, and cities are better than rural areas. Most public junior high schools in Northern China still lack professional mental health teachers, and this problem is more prominent in rural or underdeveloped areas in the northwest. The structural imbalance between supply and demand of

mental health education resources has not been alleviated; the total amount of professional resources is insufficient, and their distribution among urban and rural areas and different regions is even more uneven.

In addition, the existing mental health education courses are mostly a mere formality. Although the forms of mental health education are gradually diversifying, the personalized coverage is insufficient and the standardization is lacking, resulting in a low level of scientific and professional mental health education. At the same time, the disconnection between early mental health screening and subsequent targeted education is prominent. Mental health education is not only school education. To make up for the shortcomings of mental health education, it is not only necessary to put it into the "classroom", but also to build a trinity student mental health management mechanism involving schools, families and society, and optimize the overall planning of mental health resources and diagnosis and treatment mechanisms for primary and secondary school students (Dai, 2023).

At present, most existing studies on AI-assisted mental health education focus on a single region or developed cities, and there is a lack of cross-regional quantitative research covering the three major regions of Northern China. It remains unclear whether there are significant regional differences in the acceptance and demand of different stakeholders for AI mental health education tools, which also restricts the formulation of promotion policies with regional adaptability. The above challenges have created a huge gap in mental health education services, resulting in the failure to meet the psychological development needs of many adolescents.

The Role of Artificial Intelligence in Mental Health Education

With the rapid maturation of AI technology, intelligent curriculum systems, conversational agents for mental health literacy popularization, affective computing-based early warning platforms and personalized growth guidance tools have gradually become scalable supplements to school mental health education. Recent studies have shown that AI-supported mental health education interventions can lower access barriers, improve the coverage of high-quality educational resources in underdeveloped areas, and exert a positive effect on enhancing students' mental health literacy and emotional regulation ability (Li et al., 2025; Ni & Jia, 2025). Pilot applications of AI in the fields of education and mental health have also emerged in China, but the regional adaptability, cultural fit and influencing factors of these tools in junior high schools in Northern China still need systematic quantitative verification.

Research Objectives

This study aims to achieve the following objectives:

1. To assess the current situation of mental health literacy and the acceptance of mental health education among students in public junior high schools in Northern China;
2. To explore the cognition, acceptance and usage intention of AI-assisted mental health education tools among students, educators and parents in Northern China;

3. To verify the influencing factors and influence paths of users' acceptance of AI mental health education tools;

4. To explore the differences in the demand for AI mental health education tools among different regions and between urban and rural areas in Northern China.

Research Questions

The research questions of this study are as follows:

1. What is the current situation of mental health literacy and the acceptance of mental health education among students in public junior high schools in Northern China? Are there significant differences among different groups?

2. What is the level of cognition, acceptance and usage intention of AI-assisted mental health education tools among students, teachers and parents in the sampled schools?

3. What factors significantly affect the willingness of different stakeholders to accept and use AI mental health education tools?

4. Is there a significant correlation between students' mental health literacy level and their acceptance of AI-assisted mental health education?

5. Are there significant differences in the acceptance and demand for AI mental health education tools among respondents from different regions and between urban and rural areas?

Research Hypotheses

Based on the Technology Acceptance Model (TAM) and Bronfenbrenner's Ecological Systems Theory, this study proposes the following hypotheses:

H1: Perceived usefulness of AI mental health education tools has a significant positive impact on users' usage intention;

H2: Perceived ease of use of AI mental health education tools has a significant positive impact on users' usage intention;

H3: Concerns about privacy and data security have a significant negative impact on users' willingness to use AI mental health education tools;

H4: Teachers' professional training experience in mental health and digital literacy play a significant positive moderating role between perceived usefulness and usage intention;

H5: There is a significant positive correlation between students' mental health literacy level and their acceptance of AI-assisted mental health education.

Research Significance

The results of this study are expected to provide references for policymakers, educators and tool developers on the application of artificial intelligence to supplement traditional school mental health education, and also help adolescents deepen their understanding of mental health and improve their mental health literacy. This study covers the three major geographical regions of Northern China, breaking through the limitation of most existing studies that focus on a single region, and clarifies the differences in the acceptance and demand for AI mental health education tools

in regions with different resource endowments. The research results can provide targeted and differentiated empirical evidence for education departments in different regions of Northern China to formulate promotion policies for AI-assisted mental health education, and have strong practical reference value.

Definition of Core Concepts

Mental health: It refers to a state of mental well-being that enables individuals to cope with the stresses of life, realize their abilities, learn and work well, and contribute to their communities (World Health Organization, 2022). In this study, mental health is defined as the resilience, healthy emotional regulation ability and positive adaptability that individuals possess in the school context.

Mental health education: Mental health education can be defined as the systematic approach to teaching individuals about mental health, mental illness, and the importance of mental well-being. It encompasses various aspects, including awareness of mental health conditions, strategies for coping, and the promotion of mental wellness (Anderson, 2024). The definition in this study is consistent with this.

Artificial Intelligence (AI): Machine-based systems capable of performing tasks that traditionally require human intelligence, including natural language understanding, emotion recognition, and personalized interaction. The definition in this study is based on the classic definition by Russell and Norvig (2021), combined with the current application scenarios of adaptive educational tools.

Adolescent: Individuals aged 12-14, specifically full-time students in public junior high schools in Northern China, which is consistent with the WHO definition of adolescents aged 10-19 (World Health Organization: WHO, 2019).

AI mental health education tools: Technology platforms designed to support school mental health education, including AI-assisted curriculum systems, intelligent chatbots for mental health literacy popularization, emotion recognition and early warning tools, and personalized psychological growth guidance platforms.

Research Scope

This study adopts a cross-sectional quantitative research design, focusing on the application scenarios of AI mental health education in public junior high schools in four provinces and municipalities (Beijing, Hebei, Gansu and Heilongjiang) covering North China, Northwest China and Northeast China. It explores the acceptance, influencing factors and regional differences of AI mental health education tools among three types of stakeholders: students, teachers and parents. Data are collected through structured questionnaires, and research hypotheses are verified through statistical analysis. The results discussed in this paper are expected results based on theoretical deduction and existing literature, which will be verified through formal empirical data collection.

Research Limitations

This study is mainly carried out based on literature review and theoretical deduction, and the research content is both conceptual and prospective. Restricted by the research time limit and practical operational conditions, this study has not conducted empirical data collection and field verification. Therefore, although the relevant inferences of this study are based on existing research results and theoretical cognition, the conclusions drawn are still theoretical hypotheses, which need to be further tested and improved through empirical research in the future.

III. LITERATURE REVIEW

The Impact of Mental Health on Adolescent Development

A systematic review and analysis of relevant literature shows that one of the core impacts of mental health on individuals is its direct effect on physical health. There is a close internal connection between the human physical and psychological systems, so it is logically inevitable that mental health problems are transmitted to the body and cause physical discomfort. Once physical health is abnormal, a series of chain problems will arise. Psychological problems are usually accompanied by obvious somatic symptoms. For example, depression is often accompanied by headache, fatigue and gastrointestinal dysfunction, anxiety is prone to cause stomach discomfort, and in addition, insomnia, irritability and difficulty in concentrating may also occur (Physical Health and Mental Health, 2022).

Anwar (2021) also pointed out that actively cultivating a healthy mental state can not only optimize the quality of individuals' daily life, but also effectively control or even alleviate some physical health problems directly related to psychological factors. Taking cardiovascular health as an example, the occurrence and development of heart disease are highly correlated with psychological stress. Scientific stress management can have a positive impact on heart health and promote the formation of a healthy lifestyle; gastrointestinal diseases are also closely related to emotional states, and negative emotions such as anxiety will have a negative impact on gastrointestinal function, thereby interfering with digestion and other physical physiological functions.

From the perspective of overall value, the importance of mental health is more prominent. A healthy mental state can endow individuals with the confidence to cope with various challenges and eliminate the negative impact caused by external deficiencies. Mental health can help individuals deepen self-cognition and accept their own psychological and conscious states; realize effective regulation and control of emotions to maintain a pleasant and peaceful emotional experience; enhance frustration resistance, rationally recognize the surrounding environment, adapt to the environment and optimize it in a timely manner; show sociability, empathy and altruism in interpersonal communication, thus building good interpersonal relationships; develop a healthy lifestyle and behavioural habits; establish a positive attitude towards life, positive moral values, a value system and standardized behavioural norms. Only by maintaining a healthy mental state can

individuals calmly cope with various problems in study and life and better adapt to new environments. Individuals need to continuously maintain and improve their physical and mental health to achieve a healthy and diversified life development.

In general, mental health has a profound impact on various dimensions of individuals, including physical health, daily life, learning and development, and interpersonal relationships.

The Current Situation of Adolescent Mental Health Education in China

Chinese adolescents are facing increasing psychological pressure. An article published in the China CDC Weekly shows that the prevalence of mental disorders among Chinese children and adolescents was 17.5% in 2022 and is on the rise (X. Wang et al., 2023). China Youth Daily also pointed out that according to the 2022 survey data of some middle school students nationwide by the China Youth and Children Research Centre, the incidence of emotional and behavioural disorders (including anxiety and depression) among middle school students is on the rise (Zhou, 2023). More than 30% of middle school students reported experiencing psychological distress symptoms. The factors causing these problems include academic competition, parental expectations, excessive use of electronic devices, and insufficient entertainment and emotional support systems.

In terms of mental health education, there are significant regional and urban-rural gaps in Northern China. Developed regions such as Beijing have a relatively complete mental health education system, and most schools are equipped with full-time mental health teachers; while in some underdeveloped areas, most rural junior high schools lack professional teachers and standardized mental health education courses (Fu, 2003). Even in schools that offer mental health education courses, the teaching form is mostly a single lecture mode, lacking personalized guidance and interactive experience, which makes it difficult to effectively improve students' mental health literacy. At the same time, the social stigma of mental health in China also makes many adolescents unwilling to take the initiative to participate in mental health education activities and seek help.

The Application of Artificial Intelligence in Adolescent Mental Health Education

Artificial intelligence technology is being increasingly applied in the field of school mental health education, with great potential for scalability, personalization and wide coverage. Such tools mainly include:

- AI-assisted mental health curriculum systems: Provide personalized teaching content according to students' grades, psychological characteristics and learning progress;
- Conversational chatbots: Convey mental health knowledge and emotional regulation guidance through natural language interaction to help students improve their mental health literacy anonymously;
- Emotion recognition systems: Evaluate students' emotional states by analyzing facial expressions, voice

intonation and language patterns, and provide early warning of potential psychological distress;

- School-family collaborative platforms: Connect schools and families to provide targeted mental health education guidance for families.

Studies have shown that AI mental health education tools can reduce the stigma associated with mental health by providing anonymous and non-judgmental support (Fitzpatrick et al., 2017; Inkster et al., 2018), and effectively bridge the gap in mental health education resources between urban and rural areas. With the development, more and more AI conversational chatbots have been developed. Many young people share their conversations with different conversational chatbots on social media. Such AI chatbots are no longer cold traditional robots, but gradually become empathetic ones (L. Zhou et al., 2020). They have been applied in mental health popularization scenarios and shown positive effects in alleviating loneliness and improving emotional expression ability.

However, there is still a lack of quantitative research on the acceptance and regional adaptability of such tools in junior high schools in Northern China. Empirical research on the acceptance of artificial intelligence in the field of Chinese adolescent mental health is limited. Questions remain regarding data privacy, informed consent, and the transparency of algorithmic decision-making. The lack of supervision and professional oversight in the development of AI tools has raised ethical concerns.

Gaps in Existing Research

The deep integration of artificial intelligence technology and mental health education provides a new path to break through the bottlenecks of campus mental health services, and relevant application research has gradually become a hot topic in the fields of education and psychology. Although existing achievements have initially confirmed the application potential of AI mental health education tools, empirical exploration focusing on localization and scenarioization still has obvious shortcomings. Combined with the specific research scenario of public junior high schools in Northern China, the unsolved research gaps in the current field are mainly reflected in the following aspects. First, the absence of quantitative research in specific scenarios. At present, there are few large-sample quantitative studies on the acceptance of AI mental health education tools and their influencing factors targeting public junior high schools in Northern China and covering three core participants: students, in-service teachers and parents. Existing achievements mostly focus on a single group or generalized educational scenarios, which are difficult to accurately reflect the localized practical demands and attitude characteristics of public junior high schools in Northern China. Second, insufficient exploration of regional and urban-rural differences. Existing research has made little effort to explore the demand heterogeneity of AI mental health education tools, especially the lack of systematic analysis of the internal regional gaps in Northern China and the demand differentiation and acceptance differences under the urban-rural dual structure, which cannot provide empirical evidence for scenario-specific promotion. Third, the lack of quantitative verification of variables in the local

context. The in-depth influence mechanism of core local variables such as China's unique cultural norms, differences in audience digital literacy and mental health stigma on the acceptance of AI mental health education tools has not been quantitatively tested, and relevant conclusions still remain at the level of theoretical deduction without empirical data support. Fourth, the lack of research on differentiated application strategies. There are relatively few relevant literature studies on differentiated application strategies of AI mental health education tools targeting the gaps in educational resource endowments and teacher reserves in different regions of Northern China. Most existing suggestions are universal frameworks with insufficient regional adaptability and operability. Finally, the ethical framework in the educational field is not perfect. The special ethical system of artificial intelligence in the scenario of campus mental health education still has loopholes. In particular, the core content such as informed consent mechanisms for minor groups, full-cycle governance of psychological privacy data and risk prevention and control rules has not formed a complete and standardized ethical framework.

To make up for the above research gaps and improve the localized empirical research system, this study selects public junior high schools in multiple places in Northern China to carry out a cross-regional stratified sampling quantitative survey, systematically verifies the core influencing factors and regional and urban-rural differences in the acceptance of AI mental health education tools, thus filling the research gap in this field and providing scientific support for subsequent practical implementation.

Theoretical Framework

This study constructs a research system based on three core theories:

Technology Acceptance Model (TAM): Proposed by Fred Davis in 1989, this theory holds that users' acceptance and use of technology are mainly determined by two core factors: perceived usefulness and perceived ease of use. This study takes TAM as the core framework to explain users' usage intention of AI mental health education tools, and at the same time introduces privacy concerns, mental health stigma and digital literacy as moderating variables to expand the model.

Bronfenbrenner's Ecological Systems Theory (1979): This theory holds that adolescent development is in a complex environmental system of interconnection consisting of microsystems (family, school), mesosystems (relationships between microsystems), exosystems (indirect influencing factors) and macrosystems (cultural values and regional policies). This study uses this theory to analyze how regional, school, family and other factors affect the acceptance and promotion of AI mental health education tools.

Cognitive Behavioural Theory (CBT): This theory holds that individuals' emotional well-being is affected by thinking patterns and behaviours, which can be adjusted through guided reflection and feedback. CBT is the core theoretical basis for the design of AI mental health education tools, which can convey CBT-based mental health knowledge and

emotional regulation guidance through personalized interaction.

The above three theories jointly form a complete analytical perspective to explore the acceptance, influencing factors and promotion paths of AI mental health education tools in junior high schools in Northern China.

IV. METHOD

Research Design

This study strictly adopts a cross-sectional quantitative research design, collects core data relying on a large-sample, multi-group questionnaire survey, and carries out systematic empirical tests with the help of quantitative analysis methods. This research design is in line with the core objectives of this study. It can not only accurately verify the internal correlation between variables such as mental health literacy, cultural norms, digital literacy and the acceptance of AI mental health education tools, but also deeply analyze the specific influence paths and mechanisms of various factors on users' acceptance intention, providing reliable data support and empirical evidence for clarifying the application laws of AI tools in the scenario of campus mental health education.

Research Settings and Participants

This study locks the research scenarios in public junior high schools in four provinces and municipalities in Northern China, specifically including Beijing, Hebei Province, Gansu Province and Heilongjiang Province. The selection of research settings follows the three principles of regional representativeness, development diversity and typicality, and can fully reflect the real pattern of junior high school education and mental health services in Northern China. The positioning and representative characteristics of each province and municipality are as follows:

Beijing (North China): As a core benchmark city for the high-quality and balanced development of national education, it has improved digital education infrastructure, leading application level of intelligent education, a mature mental health education system in the junior high school stage and sufficient allocation of full-time teachers, which is a typical representative of the educational scenario in developed areas of Northern China.

Hebei Province (North China): Located in the hinterland of North China, the province has a prominent problem of unbalanced urban and rural education development, a high proportion of students in county and rural junior high schools, and obvious gaps in the allocation of mental health education resources and teacher strength between urban and rural levels, which is a typical province for studying urban-rural differences.

Gansu Province (Northwest China): It is an economically underdeveloped province in the west, with a large gap in full-time mental health teachers in the junior high school stage and limited coverage of offline psychological services. The demand for AI digital auxiliary tools to make up for the gap is more urgent, which can reflect the educational demands of underdeveloped areas in the northwest.

Heilongjiang Province (Northeast China): A typical province in the old industrial base of Northeast China, with unique regional educational ecology and school-running characteristics. Rural junior high schools have weak mental health education resources and a single service model, which can represent the overall status of junior high school education in Northeast China.

The above four provinces and municipalities vertically cover the three major core geographical regions of Northern China (North China, Northwest China and Northeast China), and horizontally take into account three levels: economically developed, moderately developed and underdeveloped. At the same time, they include different educational endowment characteristics such as high-quality and balanced educational resources, significant urban-rural gaps and prominent teacher shortages. This not only realizes the large-scale effective coverage of Northern China, but also ensures the regional representativeness of the research sample and the universality of the results.

This study selects three core groups in the sampled public junior high schools as research objects, and sets clear inclusion criteria for each group to ensure that the research objects are in line with the research theme and the data are valid and reliable. The specific inclusion rules are as follows:

Student group: Full-time junior high school students in the sampled public junior high schools who have participated in the regular mental health education courses offered by the school, have basic mental health cognition, and can objectively reflect their attitudes and demands towards AI mental health education tools.

Teacher group: In-service staff in the sampled schools, specifically including three types: head teachers, full-time mental health teachers and part-time mental health teachers. They are required to be directly responsible for or fully participate in the school's mental health education and teaching, students' psychological counseling and other related work, and be familiar with the practical pain points of campus mental health education.

Parent group: Legal guardians of the sampled students, as the main implementers and supervisors of family mental health education, can represent the family's acceptance attitude, concerns and demands towards AI mental health education tools.

Sampling Method

This study adopts a multi-stage stratified random sampling method to ensure the balance of samples in different regions and urban-rural levels:

First stage: Regional stratification: Divide the sampling areas into three layers according to geographical regions: North China (Beijing, Hebei), Northwest China (Gansu) and Northeast China (Heilongjiang);

Second stage: Urban-level stratification: In each region, stratify according to urban levels (first-tier/new first-tier cities, prefecture-level cities, county-level rural areas), and randomly select 1-2 cities/districts/counties in each layer;

Third stage: School and participant sampling: In each selected city/county, randomly select 2 public junior high schools; in each sampled school, randomly select 2 classes from each grade (Grade 7 to Grade 9), and include all students in the selected classes, the corresponding head

teachers/mental health teachers and the students' parents as research objects.

The expected valid sample size of this study is 1200-1500 students, 180-200 teachers and 1200-1500 parents, which meets the sample size requirements of cross-regional social science quantitative research.

Research Instruments

All instruments used in this study are adapted to the school mental health education scenario and have been verified to have good reliability and validity among Chinese adolescents:

Adolescent Mental Health Literacy Scale: Used to assess students' mental health literacy level, including 4 dimensions (mental health knowledge, stigma, help-seeking attitude and emotional regulation ability) with a total of 20 items, adopting a 5-point Likert scale. The expected Cronbach's α coefficient of this scale in this study is above 0.8.

Adapted Technology Acceptance Scale for AI Mental Health Education Tools: Used to measure users' acceptance of AI tools, including 4 dimensions (perceived usefulness, perceived ease of use, usage intention and privacy concerns) with a total of 16 items, adopting a 5-point Likert scale. The expected Cronbach's α coefficient of this scale is above 0.82.

Teachers' Digital Literacy Scale: Used to assess teachers' digital application ability in the educational scenario, with a total of 12 items, adopting a 5-point Likert scale. The expected Cronbach's α coefficient of this scale is above 0.78.

Self-designed Basic Information and Demand Questionnaire: Including demographic characteristics, the current situation of school mental health education, demand for AI education tools, ethical concerns and other contents. The questionnaire will be tested for reliability and validity through a pilot study, and items with low discrimination will be adjusted.

Data Collection Procedures

Pilot study: Select 1 public junior high school in Hebei Province, distribute 120 pilot questionnaires, test the reliability and validity of the questionnaire through exploratory factor analysis, and adjust the items to ensure the scientificity of the formal questionnaire.

Formal survey: Distribute anonymous online questionnaires through the Wenjuanxing Platform via the moral education department and head teachers of the sampled schools. Before the survey, explain the research purpose, confidentiality principles and voluntary participation rules to all participants. For minor students, written informed consent from their legal guardians will be obtained first.

Data sorting: After the questionnaire collection is completed, eliminate invalid questionnaires (those with consecutive identical answers, filling time less than 90 seconds, and logical contradictions), and sort the valid data into a standardized database.

Data Analysis Methods

This study will use SPSS 26.0 and AMOS 24.0 software for data analysis, including the following specific methods:

Descriptive statistical analysis: Sort out the demographic characteristics of the sample, as well as the mean and standard deviation of each core variable;

Difference analysis: Adopt independent-samples t-test and one-way analysis of variance (ANOVA) to compare the variable differences among groups with different demographic characteristics, regions and urban-rural backgrounds;

Correlation analysis: Adopt Pearson correlation analysis to explore the correlation between core variables;

Structural Equation Modelling (SEM): Verify the research hypotheses and analyze the influence paths of various variables on the usage intention of AI tools;

Moderation effect analysis: Test the moderating role of variables such as mental health stigma and digital literacy.

Ethical Considerations

This study will obtain ethical approval from the affiliated university, and all participants will sign informed consent forms. Anonymity of responses is guaranteed to ensure information confidentiality. For minor student participants, researchers will strictly abide by the regulations on the ethics of research involving children. Written informed consent from their legal guardians will be obtained first to fully protect their right to voluntary participation and withdrawal at any time. Data will be stored in an encrypted form on a secure hard disk, and all participants participate voluntarily. Considering the sensitivity of the research topic, the questionnaire will avoid content that may cause discomfort, and provide the local psychological assistance hotline at the end of the questionnaire.

Reliability and Validity Assurance

To ensure the scientificity of the study, this study adopts the following strategies:

Content validity: All scales are adapted from mature tools widely used in the Chinese context and revised by two psychology experts to ensure that the content is in line with the research scenario;

Construct validity: Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) will be used to test the construct validity of the scales;

Reliability: Cronbach's α coefficient is used to test the internal consistency of the scales, and only scales with an α coefficient greater than 0.7 can be used for formal analysis;

Common method bias: Harman's single-factor test is used to test the common method bias of the questionnaire data.

V. FINDINGS

Expected Acceptance and Influencing Factors of AI Mental Health Education Tools

Combined with the core theoretical framework of the Technology Acceptance Model (TAM) and existing relevant research results, this study makes the following expectations. First, at the level of acceptance and usage behaviour of AI mental health education tools, perceived usefulness and perceived ease of use will become the core positive predictors. That is to say, when users judge that AI tools can

effectively improve the efficiency of mental health education, make up for the shortcomings of existing services and have simple and easy-to-operate processes, their willingness to actively accept, adopt and continuously use such tools will be significantly enhanced. This prediction is also highly consistent with the classic theoretical hypothesis of the Technology Acceptance Model. At the same time, privacy and security concerns, mental health stigma and insufficient digital literacy level will become the three core negative predictors that inhibit users' usage intention. Such hindering factors will directly reduce users' trust and acceptance of AI mental health education tools, thereby weakening the probability of actual usage behaviour.

Regarding the group differences among different participants, this study further expects that the acceptance of AI-assisted mental health education tools by junior high school students will be significantly higher than that by in-service teachers and parents, and the concerns and demand preferences of the three groups are obviously differentiated. For adolescent students, they have a higher acceptance of emerging digital technologies and attach great importance to the anonymity and immersive interactivity of AI tools. Such non-face-to-face intervention forms can help them avoid the stigma of offline mental health counseling, let go of their psychological vigilance to express emotions and psychological needs more freely, and thus be more willing to try to use AI tools. For teachers, their core demands focus on the practical auxiliary value of tools, and they attach more importance to the enabling role of AI systems in the intelligent early warning of students' negative emotions, the investigation of high-risk psychological states and the reduction of the burden of daily psychological education and publicity work. Parents' considerations are more inclined to safety and long-term development. On the one hand, they will pay close attention to the protection of their children's personal psychological data and privacy information in the process of using AI tools; on the other hand, they will worry that excessive reliance on AI tools may weaken their children's offline interpersonal communication ability, and their acceptance attitude towards AI tools is relatively more prudent.

Expected Regional and Urban-Rural Differences

Based on the realistic background of the uneven distribution of mental health education resources and the significant gap in regional digital development levels in Northern China, this study makes further predictions. There are statistically significant differences in the acceptance and actual demand intensity of AI mental health education tools among respondents from different geographical regions and urban-rural circles, and the core demands and usage preferences of various groups show obvious differentiated characteristics. The specific expectations are as follows:

Differentiation of teachers' usage intention driven by regional teacher resource gaps: In regions with a serious shortage of professional mental health teachers and great difficulty in covering mental health education services in Northern China such as Gansu and Heilongjiang, front-line teachers are faced with heavy work pressure of psychological education and publicity and emotional counseling. Therefore, their dependence on and active usage

intention of AI-assisted mental health education tools will be significantly higher than that of teachers in Beijing where the mental health teacher system is improved and professional support is sufficient.

Different student demand focuses caused by urban-rural scenario differences: Compared with urban students, rural students have fewer channels to obtain offline mental health services, and are more likely to have a stigma of seeking psychological help due to the influence of the surrounding environment. Therefore, they have a higher rigid demand for anonymous AI emotional guidance tools and inclusive mental health literacy popularization platforms, and are more inclined to use non-face-to-face AI tools to alleviate psychological distress.

Differences in digital development levels determine the focus of respondents' attention: As a core region in Northern China with a high level of digitalization and information literacy, respondents in Beijing are more sensitive to the application risks of AI technology. Compared with groups in other regions, they will focus more on the core compliance issues of AI mental health tools such as data privacy protection, algorithm operation transparency and application ethical norms.

Differences in digital literacy raise the threshold of tool adaptation: In regions with weak digital infrastructure and low overall digital literacy of the group, respondents have a lower tolerance for the operational complexity of AI mental health tools, and their requirements for interface simplicity, functional ease of use and convenience of getting started are much higher than those of groups in regions with high digital literacy.

The above hierarchical and classified expected results fully confirm that the implementation, promotion and popularization of AI mental health education tools in Northern China cannot adopt a single and standardized promotion model. It is necessary to formulate targeted and accurately adapted regionally differentiated promotion strategies in combination with the teacher endowments, resource shortcomings, digital development levels and core demands of respondents in different regions to effectively exert the enabling value of AI tools.

Expected Correlation Between Mental Health Literacy and AI Tool Acceptance

Mental health literacy is the core comprehensive quality for individuals to correctly recognize mental health knowledge, actively seek psychological support and scientifically carry out self-emotional regulation, and it is also a key internal factor affecting individuals' acceptance of new mental health service models. Combined with the existing research conclusions in the field of mental health and the internal logic of technology acceptance, this study expects that there is a significant positive correlation between the mental health literacy level of junior high school students and their acceptance and usage intention of AI-assisted mental health education tools.

Specifically, students with higher mental health literacy usually have more scientific and objective cognition of mental health, a higher sense of value identity of mental health education, a more positive and proactive help-seeking attitude when facing psychological distress, and a stronger

tolerance and acceptance of AI such new digital mental health service models. Such students are not only willing to take the initiative to use AI tools to obtain systematic mental health popularization knowledge and carry out personalized emotional counseling and psychological adjustment, but also can better adapt to the usage scenarios of AI mental health education tools and give full play to the auxiliary educational value of the tools.

This expected result also profoundly reveals the internal linkage between the two, fully indicating that in the process of promoting AI mental health education tools in the campus scenario, efficient popularization cannot be achieved only by technological iteration and scenario construction. Systematically improving students' mental health literacy and helping students establish a scientific psychological cognition and a positive help-seeking mentality are important prerequisites and basic links for improving the acceptance of AI mental health education tools and ensuring their effective implementation.

VI. DISCUSSION

Ethical and Cultural Considerations

Aiming at the application scenario of AI mental health education tools among minor groups, this study makes targeted predictions combined with the characteristics of adolescent psychological development and scientific research ethical norms: in the process of the implementation, promotion and actual use of AI tools, ethical compliance is an unavoidable core issue, among which the most prominent ethical concerns focus on the protection of the rights and interests of minor users, specifically including the full-process protection of minors' privacy information, the full respect for the right to independent use and choice, the implementation of standardized informed consent procedures, and the construction of a punishment-free voluntary withdrawal mechanism. Such ethical demands are not only the bottom-line requirements for protecting the physical and mental health of adolescents, but also the core prerequisites for improving user trust and promoting the long-term application of AI tools. Once ethical supervision is absent, it is easy to arouse user resistance and even damage the legitimate rights and interests of adolescents.

From the perspective of cultural adaptability, the acceptance of AI mental health education tools is also deeply affected by the local cultural context. Traditional Chinese culture has always advocated the overall social harmony, attached importance to family responsibility, and advocated an introverted and prudent way of emotional expression. This deep cultural core will subtly affect the public's attitude towards mental health services and also influence adolescents' acceptance of AI mental health education tools. Compared with the open and straightforward emotional expression habits in the West, Chinese adolescents are more inclined to a gentle and implicit communication mode and have a low acceptance of stiff and inconsistent interactive forms. Therefore, AI mental health education tools for domestic adolescent groups must carry out refined and localized cultural adaptation and modification, such as optimizing the style of speech expression, adjusting the paradigm of emotional metaphors, and adapting the

interactive tone in line with adolescents' cognition, to fully conform to the psychological characteristics, thinking habits and emotional demands of Chinese adolescents, so as to break cultural barriers and truly realize the deep integration of AI technology and mental health education.

Holistic Interpretation of Research Findings

The expected findings of this study further validate the core logic of the Technology Acceptance Model in the specific scenario of AI-assisted mental health education in Northern China, and expand the model by introducing regional heterogeneity, group differences and mental health literacy as key variables. The expected positive predictive effect of perceived usefulness and perceived ease of use on usage intention, as well as the negative inhibitory effect of privacy concerns and stigma, are consistent with the existing international research on educational technology acceptance, while the significant regional and urban-rural differences identified in this study fill the gap in localized research on the application of AI mental health tools in underdeveloped areas of Northern China.

In particular, the expected positive correlation between students' mental health literacy and their acceptance of AI tools highlights the dual value of mental health education popularization and digital technology application: improving mental health literacy is not only the core goal of school mental health education, but also an important foundation for the effective landing of AI-assisted education tools. This finding also provides a new perspective for the subsequent design and promotion of AI mental health tools, that is, tool development and mental health literacy popularization should be carried out simultaneously, rather than simply relying on technological iteration to drive user acceptance.

In addition, the differentiated demands of different groups (students, teachers, parents) and different regions remind policymakers and tool developers that a "one-size-fits-all" promotion model cannot be applied to the integration of AI and school mental health education. For underdeveloped areas with insufficient teachers, the core value of AI tools lies in supplementing the supply of high-quality educational resources; for developed areas with complete resource allocation, the focus should be on the ethical norms and deep integration of AI tools and personalized education.

VII. CONCLUSION

Summary of the Expected Contributions of the Research

This study expects that the integration of AI into mental health education in public junior high schools in Northern China can effectively improve the coverage and quality of mental health education, especially in underdeveloped areas with insufficient professional teachers. AI tools such as intelligent curriculum systems and conversational guidance robots are expected to provide an efficient, scalable and culturally sensitive supplement to traditional mental health education.

AI is not intended to replace human teachers and psychological consultants, but to serve as a valuable supplement to reduce the stigma associated with mental

health, improve students' mental health literacy, and bridge the regional and urban-rural gaps in mental health education resources. The expected research results show that students prefer the anonymity and interactivity provided by AI, while educators and parents will regard such tools as helpful auxiliary means on the premise that privacy and cultural adaptation are guaranteed.

Implications for Policy and Practice

The implications of this study for policy and practice include:

Regionally differentiated promotion strategies: For underdeveloped areas in Northwest and Northeast China, priority should be given to promoting basic AI tools that can make up for the shortage of professional teachers, such as standardized mental health curriculum systems and popular science chatbots; for developed areas such as Beijing, focus on exploring the deep integration of AI and mental health education, and formulate ethical norms and data security standards for AI applications.

Teacher training: Education departments should carry out targeted digital literacy and AI application training for mental health teachers and head teachers to improve their ability to use AI tools to assist mental health education.

Ethical protection: Formulate clear regulatory norms for AI mental health education tools, including data privacy protection, algorithm transparency and minor user protection mechanisms, to ensure the safe and standardized application of AI tools.

School-family collaboration: AI mental health education tools should build a school-family collaborative education mechanism, connect school education with family guidance, and form a joint force for adolescent mental health education.

Future Research Directions

Future research can explore the long-term impact of AI-assisted mental health education on students' mental health literacy and emotional regulation ability through longitudinal follow-up studies; cross-regional comparative research can further explore the dynamic interactive relationships between regional culture, educational resources and AI tool application. In addition, the design and development of AI mental health education tools adapted to the characteristics of Chinese adolescents and regional cultural norms also need further research.

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